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GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF BUNAJI BULLS FED RICE STRAWS TREATED WITH NON PROTEIN NITROGEN IN MUBI ADAMAWA STATE NIGERIA

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ABSTRACT

An experiment was conducted to determine the effects of feeding Bunaji bulls using treated rice straws with non -protein nitrogen (urea and poultry litter). Ten Bunaji bulls with an average weight of 175kg were used in a completely randomized design of five treatments replicated two times. Five diets were formulated using rice straw treated with urea at two methods of ensilage (rubber plastic and polyethylene bag) making a total of two diets, similar thing was repeated for poultry litter which also has two diets and the control diets and/or other ingredients and designated as treatment I (RUERP), II (RUEPB), III (RPERP), IV (RPEPB) & V (control). Data were taken on growth performance and nutrient digestibility. Data obtained were analyzed using SPSS 25.0. Result of the growth performance showed that, daily weight gain, total weight gain, daily feed intake were significantly (P<0.01) affected by among the various treatment. Total feed intake (P<0.001) and feed conversion ratio (P<0.05) were also significantly affected by the dietary treatments. However, initial live weight and final live weight were not affected. Result of nutrient degistibility showed that ash (P<0.05), crude protein (P<0.01), dry matter, crude fibre, acid detergent fibre, neutral detergent fibre, ether extract and total digestible nitrogen (P<0.001) were significantly different among the dietary treatments. It could be concluded and recommended that; treatment of rice straw with poultry litter ensiled in polyethylene bag greatly improved weight gain of the bulls and it also disrupted the crude fibre of the cell wall of the rice straws, thereby enhanced nutrient digestibility in the straws.

Keywords: Growth performance, digestibility, Bunaji bull, rice straw, protein

INTRODUCTION

Cattle and other ruminants constitute 83 per cent of food animals and produce over 45 per cent of meat products and over 90 per cent of available domestic milk supply. Report showed that estimated population of various species of domestic ruminants in Nigeria was 22.3 million Cattle, 53 million Sheep and 99.8 million Goats (Anonymous, 2023).

The shortage of animal protein in the nation leads to the search for alternative means of boasting the supply of the production in the nation. Cattle fattening has been recognized as one of the quickest ways for a rapid increase in protein supply in the nation. Several studies have recognized the potential importance of efficiency as a means of improving productivity and supply of the animal protein in the nation (Oluwatayo *et al.,* 2003; Maurice, 2004; Ogundari and Ojo, 2006; Carlson *et al.,* 2023) and the State (Umar, 2007; Umar *et al.* 2013). Cattle fattening provides a fast source of meat to meet the high demand for high quality protein needed in the diet. This is against the backdrop of inadequate animal protein intake by most Nigerians (Ajayi *et al*., 2007). Rangeland for animals to graze only blossom in the rainy season, while in dry season, they become standing hay (Bamigboye *et al*., 2013).

Rice straw is the most abundant agricultural-byproduct in Nigeria but its utilization as animal feed is poor. The main constraint to increasing its utilization as animal feed is the poor intake and digestibility as caused by the low crude protein contents and high lignification and silicification of cell wall. One

cheap and practical way to overcome the problems is through fermentation with non –protein nitrogen either urea or poultry litter (Carlson *et al.,* 2023). Although it is produced in large quantities, utilization of rice straw as animal feed is low. Only about 20% of rice straw are used for industrial (e.g. paper, ethanol) and domestic (e.g. fodder) purposes and. most of the remaining rice straws are left in the paddy field that serving as mulch, ploughed into the paddy soil or burned (Oladosu et al 2016). Much rice straw is burned because most farmers consider that field burning is the fastest and the cheapest way to remove large volume of rice straw biomasses although this practice pollutes the air and emits greenhouse gases like methane and nitrous oxide (Gaihre et al 2014).
The study was therefore aimed at investigating the growth performance and nutrient digestibility of White Fulani bulls fed urea treated rice straws with two nitrogen sources.

MATERIALS AND METHODS

Study area

The study was conducted at the Federal Polytechnic Mubi Teaching and Research Farm Mubi, Adamawa State. Adamawa State is located in the North Eastern part of Nigeria, lying between latitudes 7^0 and 11^0N of the equator and between longitudes 11^0 and 14^0E of the Greenwich Meridian. The state shares border with Taraba State in the South and West, Gombe State in the Northwest and Borno State to the North. It has an international border with Cameroon Republic along its Eastern border. Adamawa State covers a land mass of 38,741 km^2 with a population of 3,166,101 inhabitants based on the 2006 census (Ajawara, 2007).

Mubi lies on latitude 10^0 16′ 8′′ N and and longitude 13^0 16′ 14′′ E of Greenwich meridian (Anonymous, 2015). Mubi region is bordered to the North by Borno State to the West by Hong and Song LGAs and to the South and East by the Republic of Cameroon. It has a land area of 4,728,77 km^2 and human population of 151,000 going by 2006 census figure (Adebayo, 2004; Ajawara, 2007).

Treatment of rice straws with (RS) Poultry litter (PL)

Rice straw was collected from the rice farm of Agricultural Technology Programme, Federal Polytechnic Mubi. The rice straw comprises of the leaf and straw portions. It was chopped manually using small axe to a length of approximately 3-5 cm. It was bagged and stored before use. The litter materials were obtained from Livestock Teaching and research Farm, Department of Animal Health and Production Technology, Federal Polytechnic Mubi. The litter was collected from broilers that were housed for 7 weeks on deep litter system. The litter was thoroughly raked to remove any foreign and/or caked materials as described by Abubakar (2008). The straws were treated at the ratio of 1:5:2 that is 1 kg poultry litter to 5 litres of water to 2 kg rice straw. The treated rice straw was ensiled in two methods (Rubber plastic and Polythene bags). The straw was ensiled for 21 days, after which it was air-dried for four days under shade devoid of direct sun rays.

Treatment of rice straw (RS) with Urea

Granular urea 46 % N Notere brand of Notere Industrial Park Onne Rivers State was purchased in Mubi main market. The straw was treated at the ratio of 4:100:100. That is, 4 kg of urea to 100 litres of water to 100 kg rice straw (Abubakar, 2008; Ngele *et al.,* 2010; Shua *et al*., 2011). Before treatment the rice straw was chopped using small axe to a length of about 3-4 cm long. The rice straw was treated by sprinkling and was ensiled in two different methods (Rubber plastic and Polythene bag). The straw was ensiled for 21 days, after which it was air-dried for four days under shade devoid of direct sun rays.

Experimental diet and feeding
The diets were prepared using the rice straws treated with two non-protein nitrogen (Urea or Poultry litter) and each ensiled in two methods (Rubber plastic or Polythene bags) and the following ingredients; maize bran, groundnuts cake, bone meal and salt. Percentage ingredient composition of the experimental diets is shown in Table 1.The bulls were fed about 4.38 kg of the experimental diets daily. Water was provided *ad libitum*. The rations were adjusted at regular intervals of two weeks to reflect changes in live weight.

Experimental animals and Management
Ten White Fulani (Bunaji) bulls with an average weight of 175 kg (about two years old) were used for the experiment. The bulls were purchased at Mubi international cattle market. On arrival the bulls were tagged and housed individually for identification. The bulls were given two weeks for quarantine and adjustment period before placement on the experimental diets. During the quarantine, clean water and feed (Cowpea husk and sorghum chaff) were given *ad-libitum*. Each bull was treated against ectoparasites using Amitix (Acaricides) sprayed; they were dewormed with Albendazol to take care of endoparasites and also injected intra-muscularly with Oxytetracycline 20% long acting broad spectrum antibiotic as a precautionary measure against bacterial infection. (Shua *et al*., 2021). The pens were clean daily and treatment was administered where necessary through -out the duration of 85 days trial.

Chemical analysis
The dry matter of the feed sample was determined based on weight loss after 24 hours in an oven at a temperature of 100^0C. Nitrogen content was determined by the micro Kjedahl method (AOAC, 2010) and crude protein (CP) calculated as nitrogen content multiply by 6.25 (N x 6.25). Ash content was determined by combustion in a furnace at 500^0C following the procedure of (AOAC, 2010). Organic matter was assumed to be the result of subtracting the percentage of ash from 100. Neutral detergent fibre and acid detergent fibre of the samples were determined as described by Van Soest (1991).

Data collection
Data were collected on growth performance and nutrient digestibility

Measurement of growth performance
The bulls were weighed at the beginning of the experiment for their initial weight and subsequently every fortnight by a weighing bridge. Weight of feed left over was subtracted from total feed offered to obtain the daily feed intake. Feed consumption and weight gained were used to compute the Feed Conversion Ratio (FCR).

Digestibility studies
At the end of the fattening study, five bulls were randomly selected from each treatment and housed in metabolic crates for total feacal collections. The animals were allowed ten days of adjusting to the conditions of the metabolic crates before the commencement of the digestibility study which lasted seven days. Known weights of the experimental diets were offered daily and water was given *ad libitum*. Daily feacal outputs were weighed and 5% of each day's collection was stored. This was later bulked and taken to the laboratory for proximate (AOAC, 2010), Neutral Detergent Fibre and Acid Detergent Fibre of Van Soest (Van Soest, 1991) analysis.

Data Analysis

Data collected were subjected to standard ANOVA procedures using the software package SPSS 25.0 (2017) for Windows. Treatment means were separated using Duncan multiple range test 5% level of significance.

Table 1: Percentage ingredient composition of experimental diets fed to Bunaji bulls

	TREATMENTS				
Ingredients	**TI (RUERP)**	**TII (RUEPB)**	**TIII (RPERP)**	**TIV (RPEPB)**	**TV (Control)**
RUERP	45.00	0.00	0.00	0.00	0.00
RUEPB	0.00	45.00	0.00	0.00	0.00
RPERP	0.00	0.00	45.00	0.00	0.00
RPEPB	0.00	0.00	0.00	45.00	0.00
UTRS	0.00	0.00	0.00	0.00	45.00
Maize bran	35.00	35.00	35.00	35.00	35.00
Groundnut cake	21.00	21.00	21.00	21.00	21.00
Bone meal	3.50	3.50	3.50	3.50	3.50
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100

TI (RUERP) = Rice straw treated with urea ensiled in rubber plastic
TII (RUEPB) = Rice straw treated with urea ensiled in polythene bag
TIII (RPERP) = Rice straw treated with poultry litter ensiled in rubber plastic
TIV (RPEPB) = Rice straw treated with poultry litter ensiled in polythene bag
TV (Control) = Untreated rice straw

Table 2: Chemical composition (%) of experimental diets fed to Bunaji bulls

	TREATMENTS				
Nutrients	**TI (RUERP)**	**TII (RUEPB)**	**TIII (RPERP)**	**TIV (RPEPB)**	**TV (Control)**
Dry matter	92.63	92.81	93.50	93.72	84.20
Organic matter	90.83	90.94	91.49	92.00	80.32
Crude protein	14.90	15.32	15.02	15.11	2.75
Ether extract	2.50	2.41	1.98	2.05	1.10
Total ash	9.13	9.28	9.60	10.01	16.05
NDF	50.35	51.20	48.72	48.20	78.40
ADF	30.33	29.62	31.60	31.19	52.08
Hemicellulose	13.14	12.93	14.00	13.87	28.40
Cellulose	20.40	20.45	21.09	20.31	43.60

TI (RUERP) = Rice straw treated with urea ensiled in rubber plastic, TII (RUEPB) = Rice straw treated with urea ensiled in polythene bag, TIII (RPERP) = Rice straw treated with poultry litter ensiled in rubber plastic, TIV (RPEPB) = Rice straw treated with poultry litter ensiled in polythene bag, TV (Control) = Untreated rice straw, NDF = Neutral detergent fibre, ADF = Acid detergent fibre

RESULTS AND DISCUSSION

The chemical composition of treated and untreated rice straws used in feed Bunaji bulls ensiled in two different methods is shown in Table 2. The crude protein of the diets ranged from 14.90% to 15.32%.

These fall within the range of 12.31 to 15.91% reported by Jokthan *et al.* (2013) for mature Bunaji bulls, but lower than 19.00 to 22.91% reported by Lamidi *et al.*(2007) and 19.69 to 22.44% reported by Sani *et al.* (2015). The crude fibre of 19.12 to 29.30 % of the experimental diets met the minimum level of 17% required for beef cattle (NRC, 2000). The metabolizable energy of the diets ranged between 10.72 to 12.74 MJ/kg DM which is similar to the range of 11.76 to 11.78 MJ/Kg DM recommended for bulls (Sani *et al.,* 2021). This implies that; these diets have adequate energy content and be used for fattening of cattle. The ether extract of (1.10 to 2.50 %), total ash (9.13 to 16.05 %), NDF (48.20 to 78.40 %), ADF (29.63 to 52.08 %), hemicellulose (12.93 to 28. 4o %) and cellulose (20.31 to 43.60 %) values obtained in this study is not similar to the one obtained by Jokthan *et al.* (2013) in their work with white Fulani bulls fed different energy sources. Differences in the feed ingredients used could have been why the chemical composition of the experimental diets varies.

Treatment of rice straw with either urea or poultry litter has increased the crude protein content of the diets from 8.75 to 15.32 %, this is because it has disrupted the crude fibre structure of the cell wall. Similar study of such increase in CP after treatment of rice straw have been reported by Gunun et al (2013) from 2.5 to 5.4 % and Hossaini et al. (2010) from 3.3 to 8.1%. There was decrease in NDF and ADF level from 78.40 to 48.20% and 52.08 to 29.62 % than the one obtained by Sharma et al., 2004 (NDF 88.4 to 84.1% and ADF 75.5 to 70.0 %). This indicated that the method of ensilage and concentration of materials used in the present study was better than those used by the other authors.

Growth performance of Bunaji bulls fed with treated rice straws

Growth performance of Bunaji bulls fed treated rice straws is presented in Table 3. The result showed that, there was no significant ($P<0.05$) difference in the initial and final weight of the bulls among the dietary treatments. Daily weight gain and total weight gain were significantly ($P<0.01$) affected by the treatment. Bulls fattened with rice straws treated with poultry litter ensiled in polyethylene bag recorded higher weight of 0.43 g/day than their counter parts. The level of weight gain obtained in this study is lower than those reported by (Olayiwole & Olorunju, 1986 ; Jokthan *et al.,* 2013). This difference may be attributed to the breed, experimental diets and environmental conditions used in the two experiments. The lower weight gain of 0.22g/day recorded by bulls fed control diet may probable be explain due to presence of silica, oxalic acid and lignin in the untreated rice straws which might have accounted for poor utilization. These substances are not only in digestible, but it also prevents the digestibility of other nutrient by encrusting them. The total weight gain ranges from 18.61 to 36.81 kg. This is not similar to a range of 102.25kg to 119.75 kg reported by Sani *et al*. (2021). This difference may be due to age, composition of experimental diet and duration used in the two experiments. Daily feed intake ($P<0.01$) and total feed intake ($P<0.001$) were highly significantly different among the various treatments. The daily feed intake obtained in this study did not (1.74 to 3.33 kg /day) agree with the findings of Lamidi *et al.* (2007) who obtained higher values of 6.26 to 6.45 kg/day with Bunaji bulls. The probable cause of this difference may be due to the conventional ingredients used in the formulation of their diets as compared to non -conventional ingredients used in the present study. Feed conversion ratio of 6.13 to 11.0 obtained in this study was similar to 6.00 to 7.92 obtained by Sani *et al*. (2021); Sani *et al*. (2005), this indicate the similarity in the chemical composition of the two experimental diets. Idowu (2011) and Goska *et al.* (2016) recorded high values of 13.71 to 22.4 and 8.31 to 16.16, respectively. Higher values obtained could be due to difference in the efficiency of feed utilization among the bulls used. This implies that the diets in the present study were efficiently utilized to improve feed conversion to body tissue.

Digestibility parameters

Nutrient digestibility of the Bunaji bulls is presented in Table 4. The result showed that there was significant ($P<0.05$, $P<0.01$ and $P<0.001$) effects in the nutrient digestibility of the bulls fed treated and untreated rice straw. The nutrient digestibility of all the parameters measured indicated that treatment of rice straw either with urea or poultry litters improved digestibility of nutrients. The low utilization of untreated rice straw by bulls fed control diet was mainly attributed to high neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin and silicification levels and low level of crude protein that lead to low intake, digestibility and palatability (Ravi *et al.,* 2011; Sarnklong *et al.,* 2010). Crude protein (CP) contents of untreated rice straw as reported by Nori *et al*. (2006); Aquino *et al*. (2019) was 3-5% and 4.0 – 4.6%, respectively. This is also similar to the one obtained in the present study (3.2-4.6%). These ranges of CP of untreated rice sraw reported by these authors and the present study are lower than maintenance requirement of cattle (6.1 – 7.4%) as reported by Leibholgz and Kellaway (1982).

NDF and ADF levels of the untreated rice straw were high (66.66 and 49.63%, respectively). Due to this high level of NDF and ADF in the untreated rice straw makes rice straw to be classified as low quality feed (Anonymous, 2020). Also high NDF and ADF level reduce dry matter intake and digestibility (Peripolli *et al.,* 2016). Nutrient digestibility of rice straw was increased by the treatment of rice straw with either urea or poultry litter and especially ensiled in polyethylene bags. Dry matter and CP digestibility were increased from 52.72 to 67.20% and 63.96 to 68.39% (Wanapat *et al*., 2013; Sani *et al*., 2021). NDF digestibility was increased from 66.66 (V) to 73.65% (diet IV), and ADF from 49.63 (diet V) to 57.75 % (Diet IV).

They were variation of nutrient digestibility obtained in this study than those reported by Jokthan *et al.* (2013). This difference may be explained due to composition of the experimental diets and feed utilization of the bulls used in the two experiments. Despite Bunaji bulls were used in the two experiments.

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Table 3: Growth Performance of Bunaji Bulls Fed Treated Rice Straws

Parameters	TREATMENTS					±SEM	LOS
	TI (RUERP)	TII (RUEPB)	TIII (RPERP)	TIV (RPEPB)	TV (Control)		
Initial live weight (Kg)	171.75	188.65	173.10	177.55	175.49	12.89	NS
Final live weight (Kg)	195.50	216.90	198.40	214.36	194.10	58.71	NS
Daily weight gain (kg)	0.27^{b}	0.33^{b}	0.29^{b}	0.43^{a}	0.22^{c}	0.04	**
Total weight gain (g)	23.75^{b}	28.15^{b}	25.30^{b}	36.81^{a}	18.61^{c}	3.12	**
Daily feed intake (g)	2.14^{b}	1.98b^{c}	3.19^{a}	3.33^{a}	1.74^{c}	0.15	**
Total feed intake (Kg)	182.63^{b}	168.75b^{c}	271.88^{a}	283.50^{a}	148.13^{c}	11.48	***
Feed conversion ratio	7.92^{b}	6.00^{b}	11.00^{a}	7.74^{b}	7.00^{c}	1.13	*

^{a,b,c}Mean in the row bearing different superscript (s) is significantly different P<0.05, **±**SEM = Standard error of the mean, LOS = Level of significance, NS = Not significant, * = P<0.05, ** = P<0.01, *** = P<0.001, TI (RUERP) = Rice straw treated with urea ensiled in rubber plastic, TII (RUEPB) = Rice straw treated with urea ensiled in polythene bag, TIII (RPERP) = Rice straw treated with poultry litter ensiled in rubber plastic, TIV (RPEPB) = Rice straw treated with poultry litter ensiled in polythene bag, TV (Control) = Un-treated rice straws

Table 4: Nutrient Digestibility (%) of Bunaji Bulls Fed Treated Rice Straws

Parameters (%)	TREATMENTS					±SEM	LOS
	TI (RUERP)	TII (RUEPB)	TIII (RPERP)	TIV (RPEPB)	TV (Control)		
Dry matter	62.64^{c}	61.60^{c}	65.73^{b}	67.20^{a}	52.72^{d}	0.48	***
Crude protein	65.25b^{c}	64.87^{c}	66.74^{b}	68.39^{a}	63.96^{c}	0.59	**
Crude fibre	63.05^{ab}	63.56^{a}	62.01^{b}	62.57^{ab}	56.99^{c}	0.56	***
Acid detergent fibre	50.69^{c}	52.79^{b}	57.60^{a}	57.75^{a}	49.63^{c}	0.54	***
Neutral detergent fibre	71.29^{b}	70.77^{b}	73.14^{a}	73.65^{a}	66.66^{c}	0.60	***
Ether extract	68.88^{b}	69.60^{b}	76.95^{a}	79.13^{a}	65.17^{c}	1.14	***
Total digestible nitrogen	65.93^{b}	67.08^{a}	67.71^{a}	68.00^{a}	60.70^{c}	0.52	***
Ash	42.80^{a}	42.71^{a}	42.33^{a}	42.22^{a}	40.65^{b}	0.50	*

[a,b,c]Mean in the row bearing different superscript (s) is significantly different P<0.05, ±SEM = Standard error of the mean, LOS = Level of significance, NS = Not significant, * = P<0.05, ** = P<0.01,* ** = P<0.001, TI (RUERP) = Rice straw treated with urea ensiled in rubber plastic, TII (RUEPB) = Rice straw treated with urea ensiled in polythene bag, TIII (RPERP) = Rice straw treated with poultry litter ensiled in rubber plastic, TIV (RPEPB) = Rice straw treated with poultry litter ensiled in polythene bag, TV (Control) = Un-treated rice straws.

CONCLUSION

High lignification and silicification and low crude protein contents are the main causes of the low acceptance and productivity of animal fatten with untreated rice straw. Ammoniation with urea or poultry litter increased digestibility of nutrients, reduce NDF and ADF contents and improving productivity of animals at low levels.
High level of cattle production can be attained when urea or poultry litter treated rice straw are used in combination with other ingredients especially treatment with poultry litter and ensilage in rubber plastic.

RECOMMENDATIONS

Based on the study, it could be recommended that; treatment of rice straw with poultry litter ensiled in polyethylene bag which greatly improved weight gain of the bulls and enhanced nutrient digestibility of the straws be used for feeding cattle at 3.33kg/day/bull

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